

**APPARATUS FOR LOCALIZING CLEANING
ROBOT, CLEANING ROBOT, AND
CONTROLLING METHOD OF CLEANING
ROBOT**

**CROSS-REFERENCE TO RELATED
APPLICATIONS**

[0001] This application claims the benefit of Korean Patent Application Nos. 10-2015-0132274, filed on Sep. 18, 2015 and 10-2015-0148434, filed on Oct. 26, 2015, respectively, in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference.

BACKGROUND

[0002] 1. Field

[0003] Embodiments of the present disclosure relate to an apparatus for localizing a cleaning robot, the cleaning robot, and a control method for the cleaning robot.

[0004] 2. Description of the Related Art

[0005] A cleaning robot is an apparatus that cleans impurities such as dust from the floor while traveling an area to be cleaned by itself even without a user's operation, and performs a cleaning operation while traveling according to a traveling pattern set in advance. In addition, the cleaning robot determines a distance to obstacles such as furniture, walls, appliances, or the like installed in a cleaning area using a sensor, and switches a direction by itself by selectively driving a left motor and a right motor.

[0006] In order for the above-described cleaning robot to perform a smooth cleaning operation in a variety of cleaning environments, it is important to accurately determine its position. The determination of the position of the cleaning robot is achieved in such a manner as to estimate a current position of the cleaning robot using data measured by an environmental map in which the cleaning robot is operated and a sensor.

[0007] A technique that is most commonly used as a method of determining the position using a map is a Monte Carlo localization (hereinafter, referred to as "MCL") method based on a particle filter. In the MCL method in which a particle filter is implemented to determine the position of the cleaning robot, particles indicating a virtual position of the cleaning robot within a predetermined area are randomly sampled on a map (random sampling), and the cleaning robot repeatedly performs an operation for converging the particles while moving a predetermined distance in an arbitrary direction. Through this process, the particles may be finally converged into one position, and the converged position may be recognized as the current position of the cleaning robot.

[0008] However, such a localization method is likely to fail to localize the cleaning robot when the number of the used particles is small, and a calculation time for localization is increased when the number of the particles is large. In addition, the cleaning robot should meaninglessly move the predetermined distance in the arbitrary direction in order to converge the particles into one position, which is significantly inefficient.

[0009] In addition, assuming that the cleaning robot is placed to be inclined against a wall surface, when the cleaning robot starts to clean while maintaining a direction in which the cleaning robot is initially positioned, an inef-

ficient traveling route may be generated, so that there may be a lot of areas in which cleaning is missed.

[0010] Therefore, there is the need to accurately determine a traveling direction of a cleaning robot so that the cleaning robot may travel all areas of the cleaning space.

SUMMARY

[0011] Therefore, it is an aspect of the present disclosure to provide an apparatus for localizing a cleaning robot, which may quickly and accurately recognize a current position of the cleaning robot in place without an unnecessary movement when the cleaning robot is moved to an arbitrary position by a user and determine a traveling direction of the cleaning robot using an environmental map in which the cleaning robot performs a cleaning operation and a position of the cleaning robot on the map, the cleaning robot, and a control method of the cleaning robot.

[0012] Additional aspects of the disclosure will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the disclosure.

[0013] In accordance with one aspect of the present disclosure, a cleaning robot includes: a data acquisition unit that acquires actual sensor data by measuring a distance from a current position to an object to be measured; a local map acquisition unit that acquires a local map by scanning the vicinity of the current position based on an environmental map stored in advance; and a processor that determines coordinates of the current position for the local map by performing matching between the local map and the actual sensor data, and determines a traveling direction based on the current position by calculating a main segment angle of a line segment existing in the local map.

[0014] The processor may determine the main segment angle by classifying a plurality of straight lines existing in the local map according to angles.

[0015] The processor may rotate the traveling direction of the cleaning robot in place on the basis of the traveling direction determined based on the coordinates of the current position.

[0016] The data acquisition unit may acquire the actual sensor data in a state in which the cleaning robot is stopped, acquires the actual sensor data while the cleaning robot rotates at a predetermined angle in place, or acquires the actual sensor data for all directions while the cleaning robot rotates at an angle of 360 degrees in place.

[0017] The local map acquisition unit may extract virtual sensor data by performing a ray casting method on all directions while the cleaning robot rotates at an angle of 360 degrees in a virtual sensor data extraction position selected with respect to the current position of the cleaning robot, and thereby acquires the local map.

[0018] The local map acquisition unit may extract the local map having a predetermined size with respect to each of a plurality of local map extraction positions selected with respect to the current position of the cleaning robot, from the environmental map.

[0019] The processor may further include: a position estimation unit that determines current position coordinates of the cleaning robot for the local map, a segment angle calculation unit that calculates a main segment angle of a line segment existing in the local map, and a direction